

Degradation half lives for select chemicals in soils, sediments, and surface waters*.										
Chemical	Half Life (days) Sediment/Soils					Half Life (days) Waters				
	Slow	Mid**	Fast	Matrix	Ref.	Slow	Mid**	Fast	Matrix	Ref.
Tributyltin	150	120	112	Sed	(10)	140	9.0	4.0	SW	(10)
	160	15	2	Sed	(12)	150	11.0	2.5	SW	(12)
	inf (1898)	374	113	Sed	(13)					
Bis(2-ethylhexyl)phthalate	389	-	5.0	Various	(3)	23	-	5.0	SW	(3)
	495	187	63	Sed	(6)	inf (173)	20	5.3	SW	(6)
	347	44	8.5	Soil	(6)	32	21	2.9	SW	(10)
	inf (200)	31	14	Soil/Sed	(10)					
Benzo(a)pyrene	2120	644	57	Soil/GW	(3)	530	-	57	SW	(3)
	inf (11,552)	315	12	Soil	(6)	431	-	207	SW	(3)
	inf (2100)	330	85	Sed	(6)	inf.	-	462	SW	(6)
	2993	269	2.1	Soil	(4)	-	825	-	SW	(4)
	inf (2100)	741	54	Sed	(10)					
	inf (2993)	290	82	Soil	(10)					
Naphthalene	125	-	0.12	Soil	(4)	550	-	0.67	SW	(4)
	219	-	0.20	Sed/GW	(4)	20	-	0.50	SW	(3)
	258	25	1.0	Various	(3)	178	8.0	0.29	SW	(6)
	72	17	0.21	Sed	(6)	43	9.0	2.9	SW	(10)
	inf (99)	6.9	1.8	Soil	(6)					
	inf (3851)	130	2.3	GW/Soil	(11)					
	inf (18)	7.0	2.0	Soil	(10)					
	inf (88)	17	0.13	Sed/GW	(10)					
DDD	11,425	730	70	Soil/GW	(3)	5833	-	730	SW	(3)
	5776	1005	730	Soil	(7)	-	10,193	-	SW	(7)
	-	160	-	Soil	(10)	inf (69,350)	31,390	570	SW	(10)
	-	inf	-	Sed	(10)					
DDT	11,425	730	16	Soil/GW	(3)	5833	350	7.0	SW	(3)
	5776	2806	110	Soil	(7)	8060	347	7.0	SW	(7)
	12,775	730	31	Soil	(10)	inf (54,750)	4380	81	SW	(10)
PCBs***	inf (180,713)	20,440	50	Soil/Sed	various	inf (180,713)	20,440	50	SW	various

\* In cases where very limited data are available groundwater, and/or marine degradation rates were also compiled. Anaerobic and aerobic rates shown for sediment and aerobic rates shown for water, unless very limited data available.

\*\*Mid - Central tendency estimate as reported (e.g., median, mean, mid-range), only value reported, or median calculated from multiple reports in reference.

\*\*\* A large number of PCB degradation rates exist that are for specific congeners or congener groups. This table provides an overall summary of the range of PCB degradation rates found. To refine these ranges, the specific congeners for modeling need to be selected.

inf. - slowest rate was no degradation reported (maximum measured half life reported in parenthesis).

NA - Not applicable

Sed - Sediment

SW - Fresh surface waters

GW - Groundwater

\*Statistic not reported or addressed.

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- (6) Aronson, D et al., (1999) Aerobic Biodegradation of Organic Chemicals in Environmental Media: A Summary of Field and Laboratory studies. Prepared for the U.S. Environmental Protection Agency, Athens GA
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## EPA Comments on Proposed Chemical Degradation Rates:

### **Introduction:**

Chemical degradation rates are a key component of the contaminant fate and transport model for the Portland Harbor site. Further, sediment half-life has been identified as a sensitive parameter in the hybrid model report. In the hybrid model report, sediment half-life was used as a calibration parameter. However, EPA did not believe that the calibration data set was sufficient to calibrate the model and instead proposed a model testing approach. For the model testing approach, EPA recommended evaluating the literature to select initial sediment half-life values, running the model, evaluating model performance and adjusting the sediment half-life as necessary.

On July 24, 2008, the Lower Willamette Group submitted a table of chemical degradation rates for fate and transport modeling. EPA agreed to review the rate ranges and select several increments that LWG should use in the model testing phase.

### **Comments:**

The chemicals presented in the table shown here are consistent with the agreed upon list of chemicals for fate and transport modeling. EPA acknowledges that specific PCB congeners for modeling need to be selected. EPA expects that the determination of which PCB congeners will be modeled will be determined in conjunction with our discussions of which congeners will be selected for PRG development.

For most of the chemicals of concern (COCs), EPA recommends using the slow or mid-range half lives presented in the table. The values presented are generally conservative and match values readily available in on-line search engines such as the PBT Profiler ([www.pbtprofiler.net](http://www.pbtprofiler.net)) and the HSDB (<http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>). The latter database was included in the references to the table of half lives. However, for some chemicals, selection of a half life is problematic. For example, many PCB congeners do not degrade all the way to non-toxic daughter products, so a fraction of the PCBs may ultimately disappear, but the remainder persists indefinitely. The same is true of DDT and DDD as well which typically degrade to DDMU and stop. In general, literature-based degradation rates are estimated based on the disappearance rates of the starting chemical and are typically not mineralization rates. As a result, sediment half-lives should approach infinity for DDD, DDT and PCBs. In summary EPA recommends using a half-life of  $10^{10}$  for PCBs, DDD and DDT and use the largest or mid-range half lives for the other chemicals.

## Responses to EPA Comments on Proposed Degradation Rates

EPA provided comments to LWG on September 23, 2008 on Proposed Degradation Rates that were presented in an Excel table submitted to EPA on July 24, 2008. This document contains responses to EPA's comments.

### **Comment 1:**

Introduction: Chemical degradation rates are a key component of the contaminant fate and transport model for the Portland Harbor site. Further, sediment half-life has been identified as a sensitive parameter in the hybrid model report. In the hybrid model report, sediment half-life was used as a calibration parameter. However, EPA did not believe that the calibration data set was sufficient to calibrate the model and instead proposed a model testing approach. For the model testing approach, EPA recommended evaluating the literature to select initial sediment half-life values, running the model, evaluating model performance and adjusting the sediment half-life as necessary.

On July 24, 2008, the Lower Willamette Group submitted a table of chemical degradation rates for fate and transport modeling. EPA agreed to review the rate ranges and select several increments that LWG should use in the model testing phase.

**Response:** We agree the comment accurately reflects the history of this issue.

**Comment 2:** The chemicals presented in the table shown here are consistent with the agreed upon list of chemicals for fate and transport modeling. EPA acknowledges that specific PCB congeners for modeling need to be selected. EPA expects that the determination of which PCB congeners will be modeled will be determined in conjunction with our discussions of which congeners will be selected for PRG development.

**Response:** LWG's proposal for modeling PCB congeners is described in the LWG memo *Responses to EPA's Comments on Appendix E of the Comprehensive Round 2 Site Characterization Summary and Data Gaps Report (dated August 8, 2008)* submitted to EPA on October 3, 2008. It states: "In addition, the LWG is proceeding with AFT modeling (and eventually dynamic FWM modeling) for PCB 126 and 77. These congeners were selected for AFT modeling because, based on a review of the Portland Harbor BLRA tissue concentration data, they are the greatest contributors to potential PCB TEQ risks in mammals (human and wildlife) and birds, respectively."

**Comment 3:** For most of the chemicals of concern (COCs), EPA recommends using the slow or mid-range half lives presented in the table. The values presented are generally conservative and match values readily available in on-line search engines such as the PBT Profiler ([www.pbtprofiler.net](http://www.pbtprofiler.net)) and the HSDB (<http://toxnet.nlm.nih.gov/cgi-bin/sis/htmlgen?HSDB>). The latter database was included in the references to the table of half lives.

**Response:** The LWG agrees to use the slow and mid-range half lives in the table in the model testing.

**Comment 4:** However, for some chemicals, selection of a half life is problematic. For example, many PCB congeners do not degrade all the way to non-toxic daughter products, so a fraction of the PCBs may ultimately disappear, but the remainder persists indefinitely. The same is true of DDT and DDD as well which typically degrade to DDMU and stop. In general, literature-based degradation rates are estimated based on the disappearance rates of the starting chemical and are typically not mineralization rates.

**Response:** The LWG disagrees with EPA's statements that some compounds do not degrade all the way to non-toxic daughter products and that DDT and DDD typically degrade to DDMU and stop. The idea of so-called non-toxic daughter compounds is contrary to the fundamentals of toxicology in which all substances are toxic and the dose makes the poison. In some cases, degradation can result in transformation and bioactivation of daughter compounds that are more toxic than the parent compound. More often, degradation occurs by mechanisms that reduce but don't eliminate toxicity of intermediate products. Hence, all compound groups most likely yield intermediate products with some level of toxicity, which are likely to be present until the parent compound is completely degraded. Also, DDMU is not a terminal product in degradation of DDT and DDD. There are many other intermediate degradation products. Also, depending on site conditions, DDT and DDD may be completely degraded over time (see references provided at end of responses).

However, LWG intends to use a range of very slow degradation rates as described in the next response.

**Comment 5:** As a result, sediment half-lives should approach infinity for DDD, DDT and PCBs. In summary EPA recommends using a half-life of  $10^{10}$  for PCBs, DDD and DDT and use the largest or mid-range half lives for the other chemicals.

**Response:** LWG sought clarification on this issue and the email questions and responses below present our understanding of the agreed path forward.

From Carl Stivers (LWG): Chip - Thanks for the email on the degradation rates. I want to make sure I've got the EPA direction correctly. We will use the mid and slow range values for all chemicals (except those noted below) for model testing purposes.

For the exceptions, DDD, DDT, and PCBs, we will use rates on the order of  $10^{10}$  days. My main question is that we discussed using a range for model testing. What do we do if  $10^{10}$  does not test out well for these chemicals? Should we just stop there and consult EPA, or are we allowed to try out something similar to the slow ranges shown in our table.

This latter course of action would seem to make more sense to me to make our check in meeting to discuss model testing more useful. All first runs of model results will be considered for discussion purposes only in any case.

Please confirm your understanding. Thanks.

From Chip Humphrey: Carl - I agree with the approach (trying other values if  $10^{10}$  doesn't work) but am concerned about jumping to the table values for DDT and DDD unless the model will account for breakdown to other toxic compounds.

From Carl Stivers: Chip - Thanks for the reply. We don't have to jump all the way up to the table values for DDT and DDD, we can try increments slower than those. I just did not want to be locked into only one value, which kind of defeats the purpose of the exercise.

From Chip Humphrey: Sounds workable to me.

## REFERENCES

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## Carl Stivers

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**From:** Humphrey.Chip@epamail.epa.gov  
**Sent:** Friday, September 26, 2008 1:07 PM  
**To:** Carl Stivers  
**Subject:** RE: Degradation Rates

Sounds workable to me.

"Carl Stivers"  
<cstivers@anchorenv.com>

09/26/2008 11:40  
AM

To  
Chip Humphrey/R10/USEPA/US@EPA  
cc  
Subject  
RE: Degradation Rates

Chip - Thanks for the reply. We don't have to jump all the way up to the table values for DDT and DDD, we can try increments slower than those. I just did not want to be locked into only one value, which kind of defeats the purpose of the exercise.

Thanks.

Carl

Carl Stivers  
Anchor Environmental, L.L.C.  
23 South Wenatchee Avenue, Suite 120  
Wenatchee, WA 98801  
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-----Original Message-----

From: Humphrey.Chip@epamail.epa.gov  
[mailto:Humphrey.Chip@epamail.epa.gov]  
Sent: Wednesday, September 24, 2008 4:29 PM  
To: Carl Stivers  
Subject: Re: Degradation Rates

Carl - I agree with the approach (trying other values if  $10^{10}$  doesn't work) but am concerned about jumping to the table values for DDT and DDD unless the model will account for breakdown to other toxic compounds.

"Carl Stivers"  
<cstivers@anchorenv.com>

09/24/2008 08:12  
AM

Chip Humphrey/R10/USEPA/US@EPA  
To  
cc

Degradation Rates  
Subject

Chip - Thanks for the email on the degradation rates. I want to make sure I've got the EPA direction correctly. We will use the mid and slow range values for all chemicals (except those noted below) for model testing purposes.

For the exceptions, DDD, DDT, and PCBs, we will use rates on the order of  $10^{10}$  days. My main question is that we discussed using a range for model testing. What do we do if  $10^{10}$  does not test out well for these chemicals? Should we just stop there and consult EPA, or are we allowed to try out something similar to the slow ranges shown in our table. This latter course of action would seem to make more sense to me to make our check in meeting to discuss model testing more useful. All first runs of model results will be considered for discussion purposes only in any case.

Please confirm your understanding. Thanks.

Carl

Carl Stivers  
cstivers@anchorenv.com

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